How Poor Air Quality Affects Children's Health

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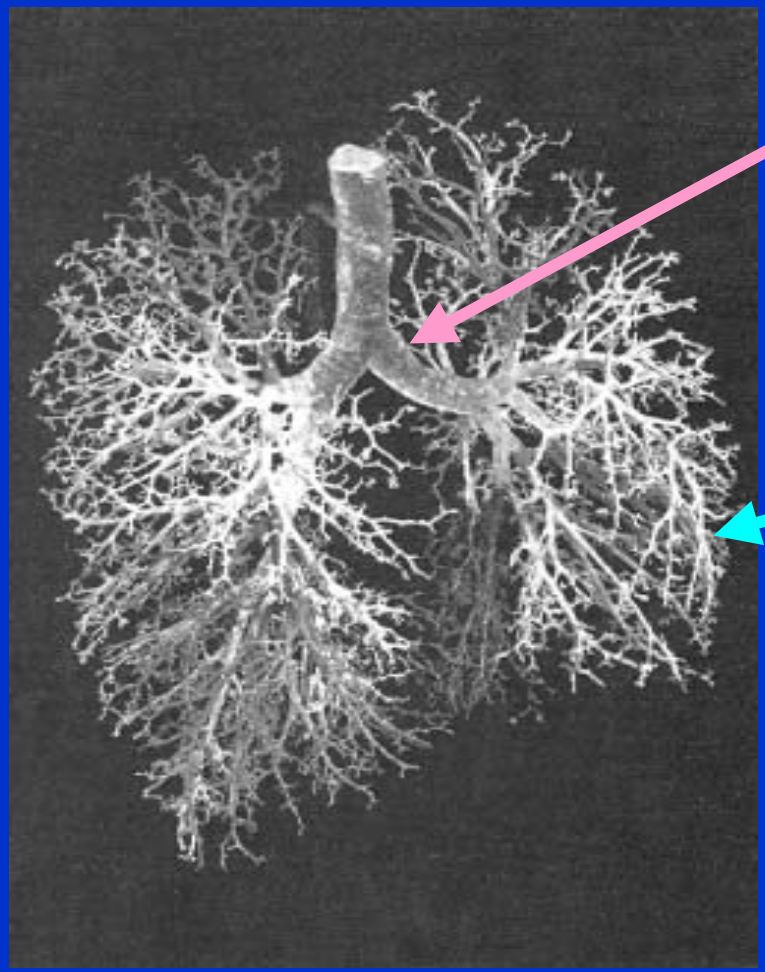
Common Air Pollutants and Asthma

- People with asthma considered to be sensitive to four :
  - Ozone
  - Particulate matter (PM)
  - Sulfur dioxide
  - Nitrogen dioxide
- Ozone and PM present most serious risk

Human Lung



- Air conducting
  - Trachea
  - Bronchi
  - Bronchioles
- Gas exchange
  - Respiratory bronchioles
  - Alveoli

Ozone

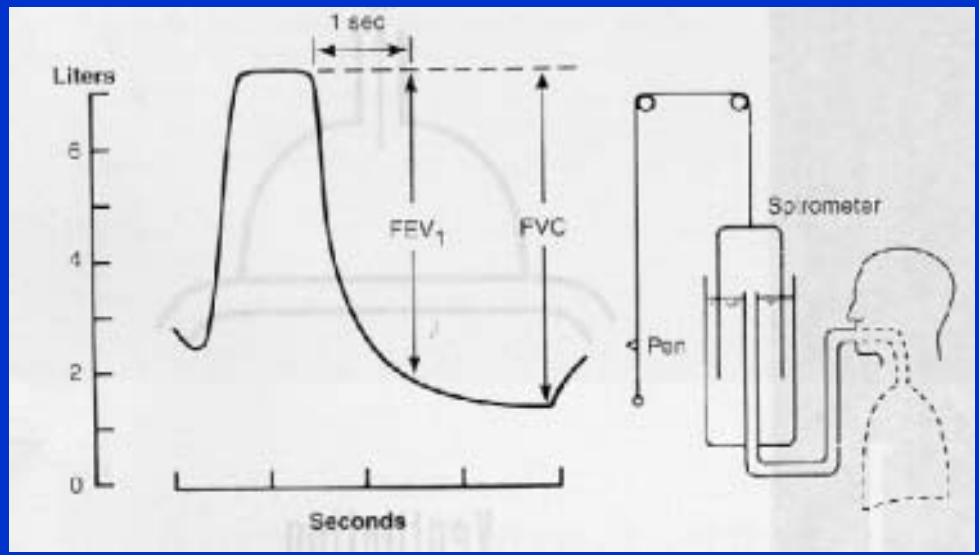
- Formed by chemical reactions involving various gases in motor vehicle exhaust and industrial emissions
- Levels tend to be lower in morning and peak in afternoon
- Major component of urban smog
- Powerful respiratory irritant that causes early and late effects
- Exposure for 1 or more hours with exercise can cause respiratory symptoms, reduced lung function, and lung inflammation

Ozone Irritates Airways

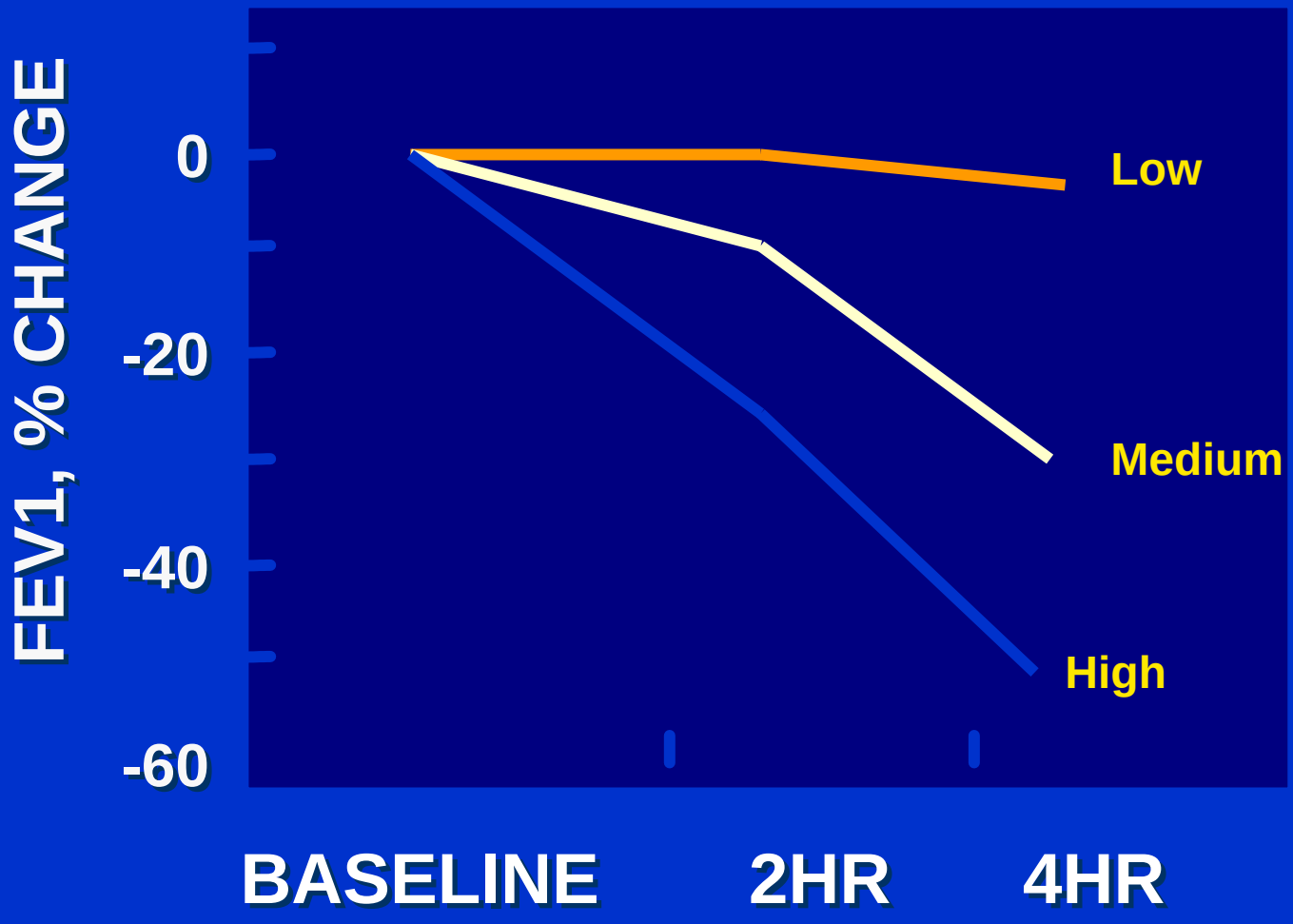
- Acute Symptoms
  - Cough
  - Sore or scratchy throat
  - Pain with deep breath, or chest pain
  - Fatigue
- Rapid onset
- Similar symptoms - people with and without asthma

Ozone Reduces Lung Function

- Forced Expiratory Volume (FEV_1) -volume of gas exhaled in one second
- Forced Vital Capacity (FVC) - total volume of gas exhaled



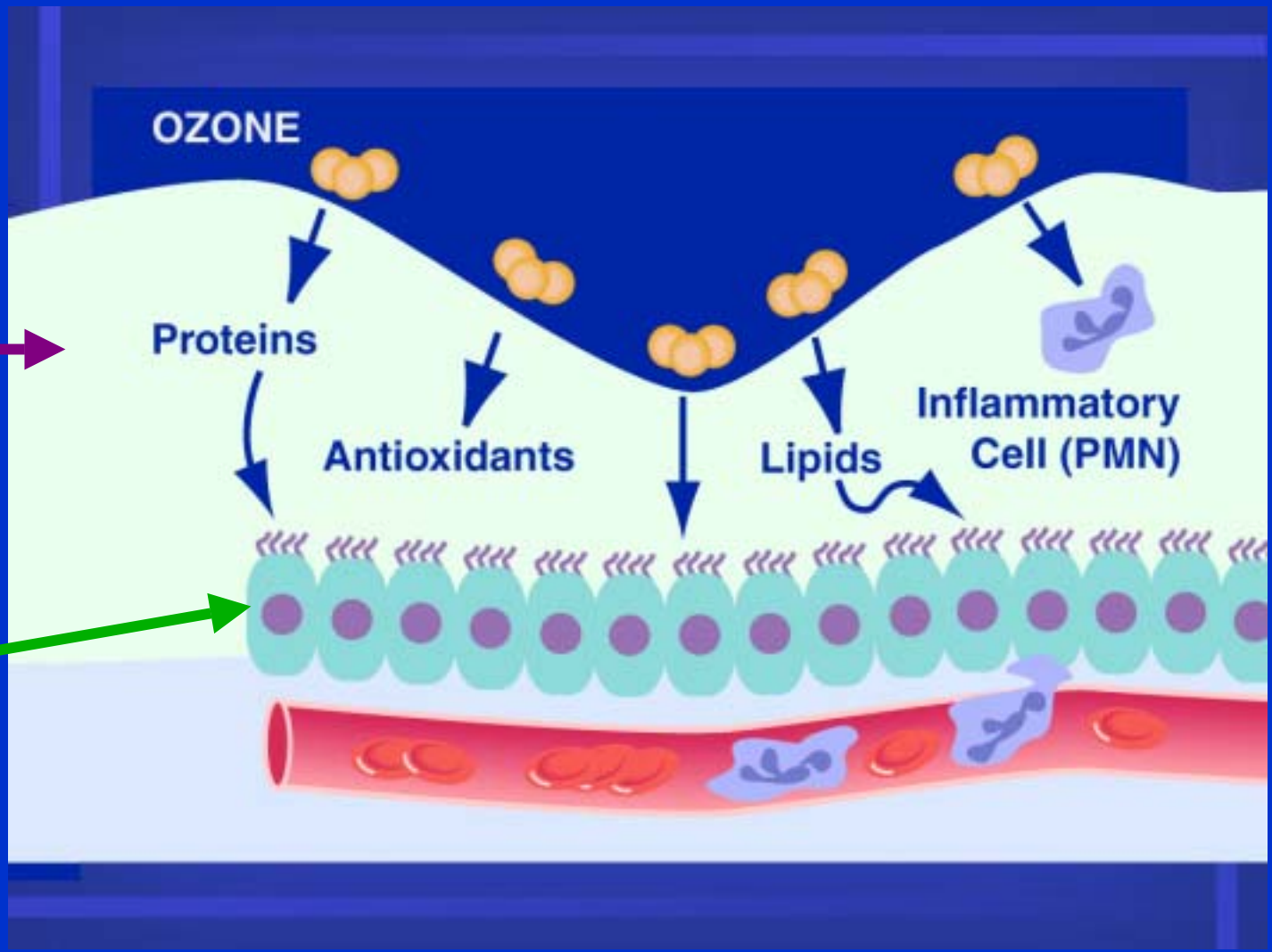
Variability of Ozone Response



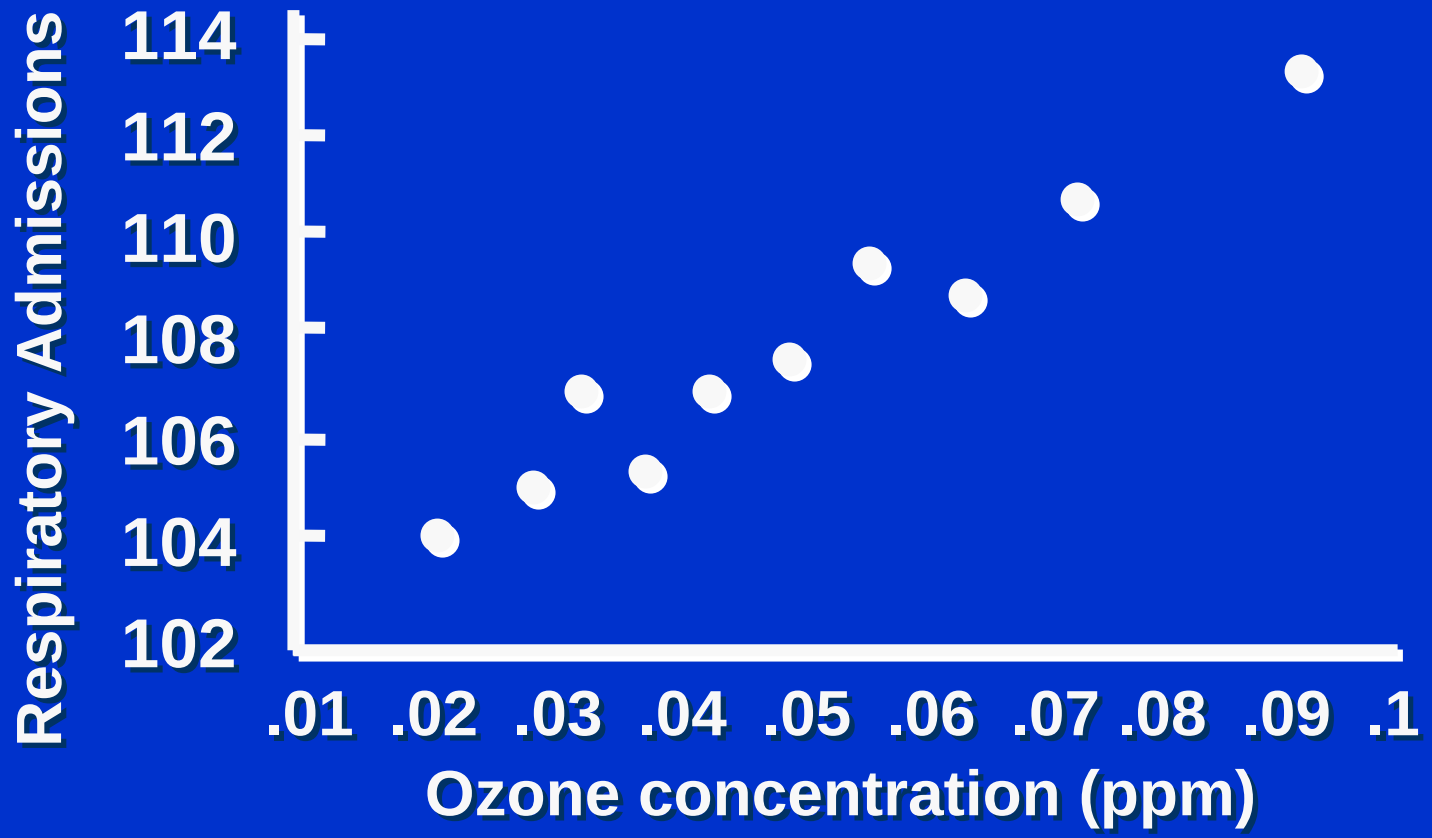
Ozone Causes Inflammation

Epithelial Lining Fluid

Lung Epithelium



Respiratory Hospital Admissions by Daily Maximum Ozone Level, Lagged One Day (Burnett et al, 1994)



Respiratory Health Effects of Ground-level Ozone Exposure

- Aggravated asthma
- Reduced lung capacity and lung function
- Increased susceptibility to respiratory illnesses
- Increased school absences
- Increased respiratory hospitalizations.
- Possibly new cases of asthma

Exposure risk in children

- Narrower airways
- Lungs are still developing and are more susceptible to damage.
- 50% more time outdoors
- More time engaged in vigorous activity (especially in the summertime when ozone levels are the highest)
- Higher breathing rate relative to body weight and lung surface area.
- Results in greater dose of pollution delivered to their lungs

Exercise Induced Asthma (EIA)
Exercise Induced Bronchospasm (EIB)

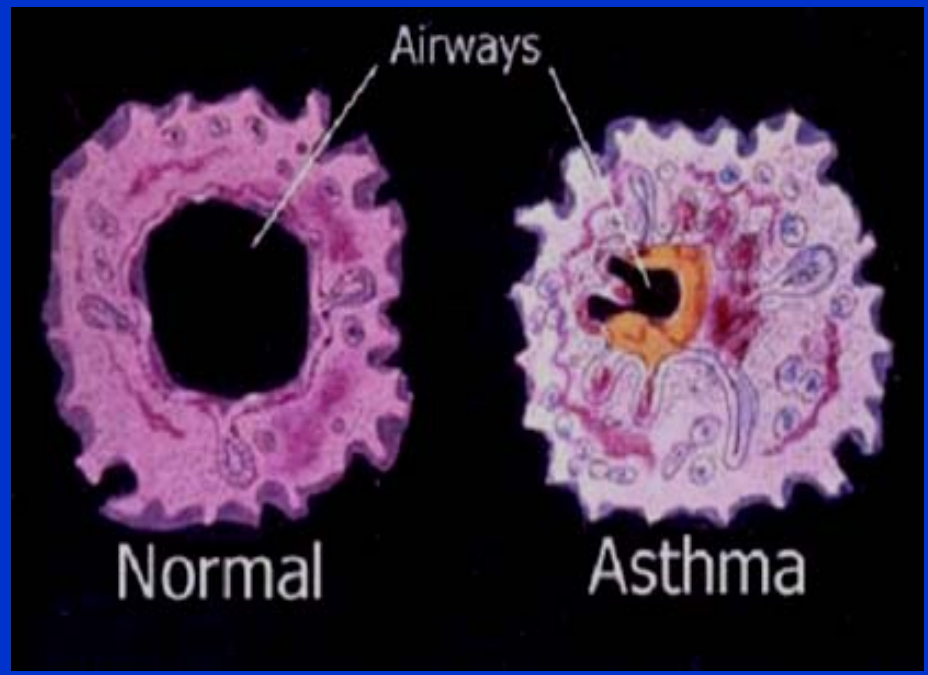
- EIB is a very common symptom for persons with asthma.
- 80-90% percent of asthmatics have difficulty breathing with vigorous exercise.
- Children who have not been diagnosed with asthma may develop breathing problems with vigorous exercise.
  - 50% of people with hay fever or allergic rhinitis (allergic runny nose)
  - 10% of normal athletes have been found to develop EIB.

Symptoms of Exercise Induced Asthma

- **Obvious Symptoms:** wheezing, shortness of breath on exertion, chest tightness
- **Subtle Symptoms:** cough, chest congestion, chest discomfort or pain, susceptibility to cold air, tires easily, unable to run five minutes without stopping, dizziness, frequent throat clearing sounds
- **Timing:**
  - Occurs following 6-8 minutes of vigorous exercise
  - Peaks 5-10 minutes after exercise
  - Lasts 30 - 60 minutes
  - Less severe late phase may occur—symptoms begin again 12-16 hours after exercise; resolves within 24 hours

Asthma Medications

- Asthma **Relievers**
  - Bronchodilators (albuterol)
  - Help to relieve asthma symptoms temporarily, provide quick relief as needed
- Asthma **Controllers**
  - Anti-inflammatories
  - Long-acting bronchodilators
  - Help to control asthma over time and prevent asthma symptoms or attacks



AQI

Descriptors	Index Values	Risk Message
Good	0 – 50	No message
Moderate	51 – 100	Unusually sensitive individuals
Unhealthy for Sensitive Groups	101 – 150	Identifiable groups at risk – different groups for different pollutants
Unhealthy	151 – 200	General public at risk; groups at greater risk
Very Unhealthy	201 – 300	General public at greater risk; groups at greatest risk

Sensitive Groups

- “unusually sensitive individuals”
  - known to be unusually susceptible to ozone
- “sensitive individuals”
  - persons with chronic lung disease or asthma
  - elderly, chronically ill
  - active adults and children

Physical Activity

- DHS Physical Activity Guidelines
  - Elementary school children (30-60 minutes/day)
  - Adolescents (60 minutes/day)
- Moderate Exercise Activities
  - Brisk walk, climbing stairs, tennis, baseball, cycling, hiking
- Vigorous Exercise Activities
  - Basketball, soccer, running (sprints, time trials), cycling (competitive), hiking (uphill), rope skipping, swimming

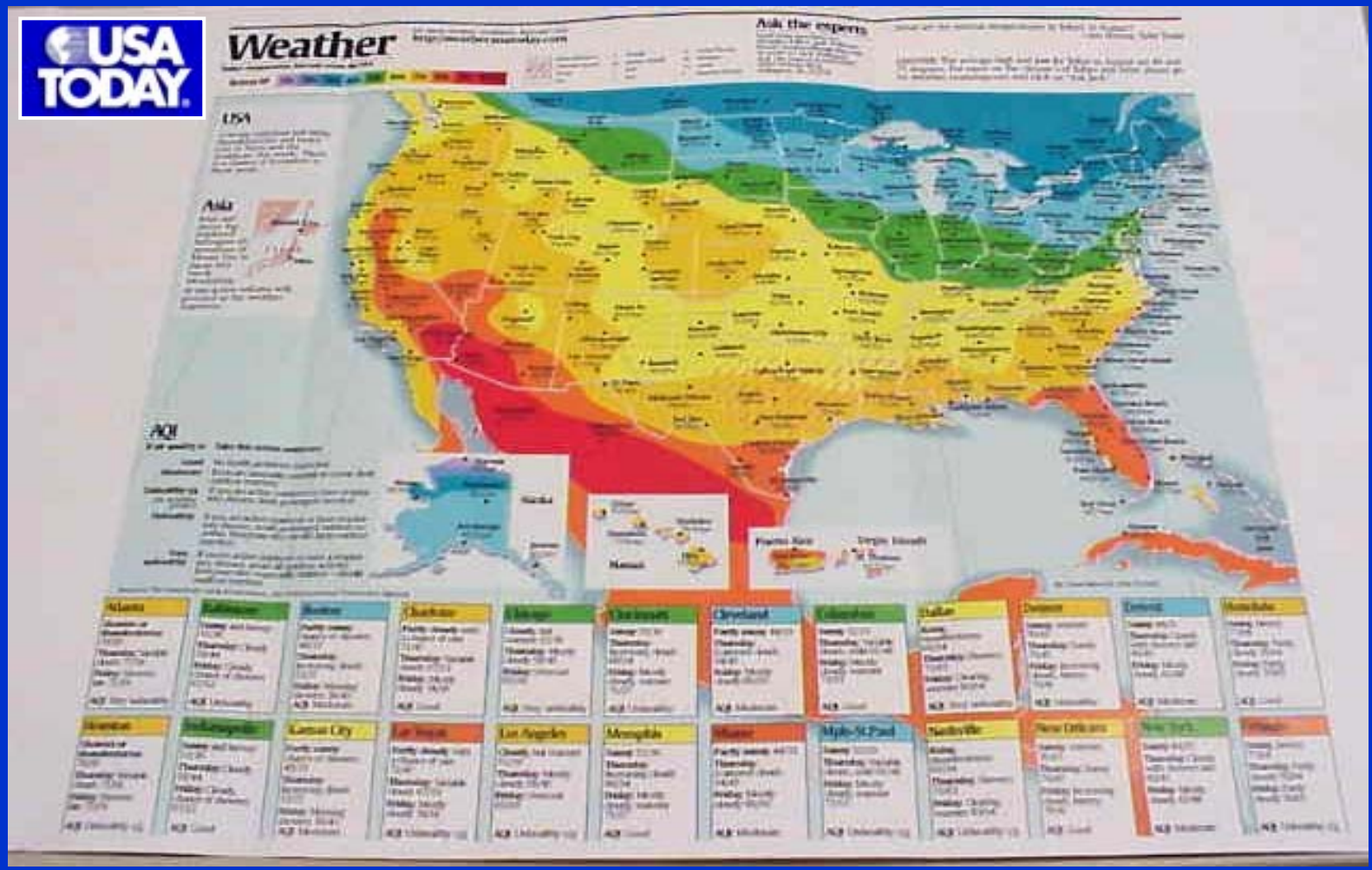
How to Reduce Risk

Dose = Concentration x Ventilation Rate x Time

- Reduce concentration – schedule activities when pollution levels lower
- Reduce ventilation rate by taking it easier
- Reduce time spent in vigorous outdoor activities

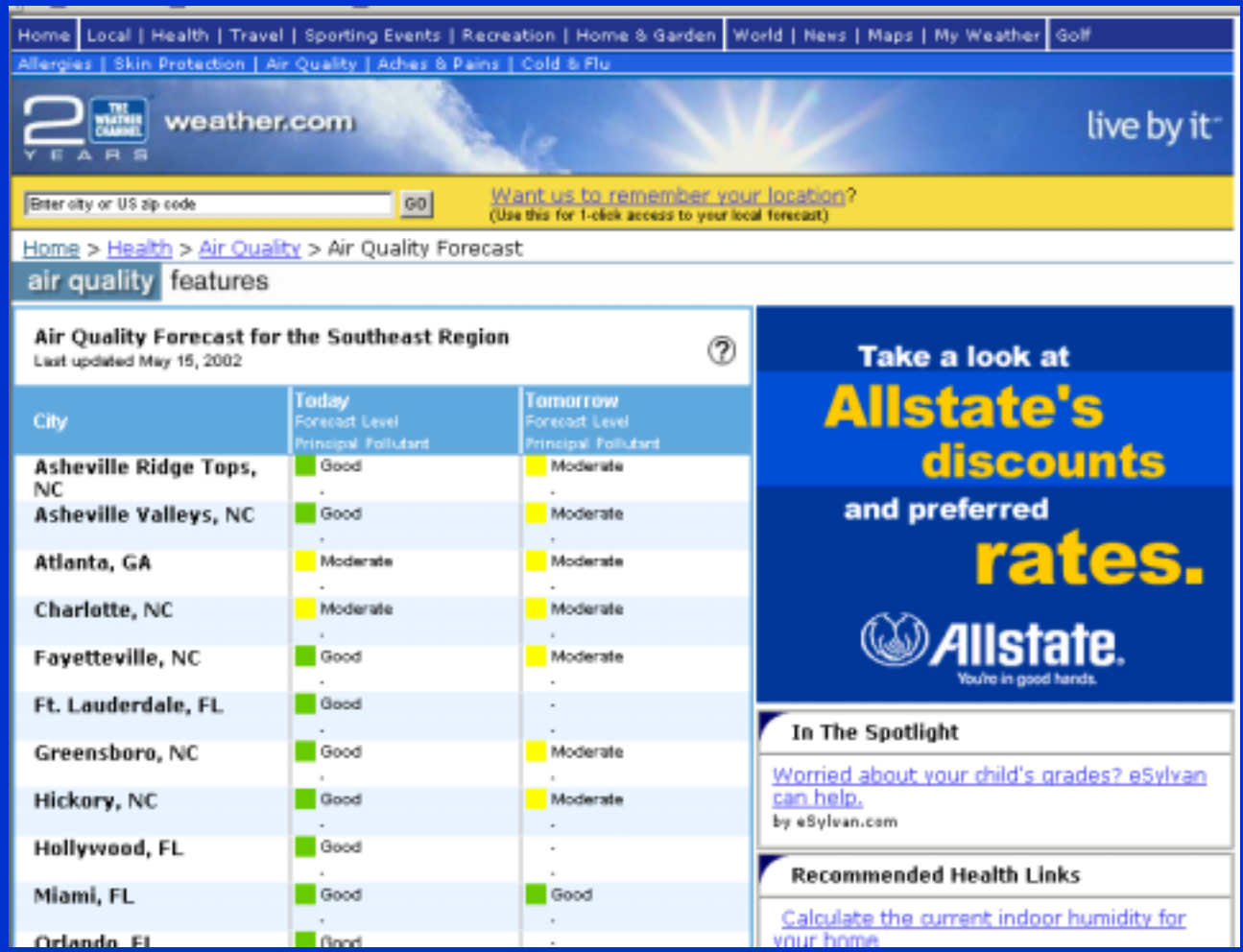
- Pay attention to symptoms
- Follow asthma action plan – notice changes
- Coaches – rotate players frequently
- Risk trade-offs

Daily Air Quality Forecasts



USA Today and USAToday.com

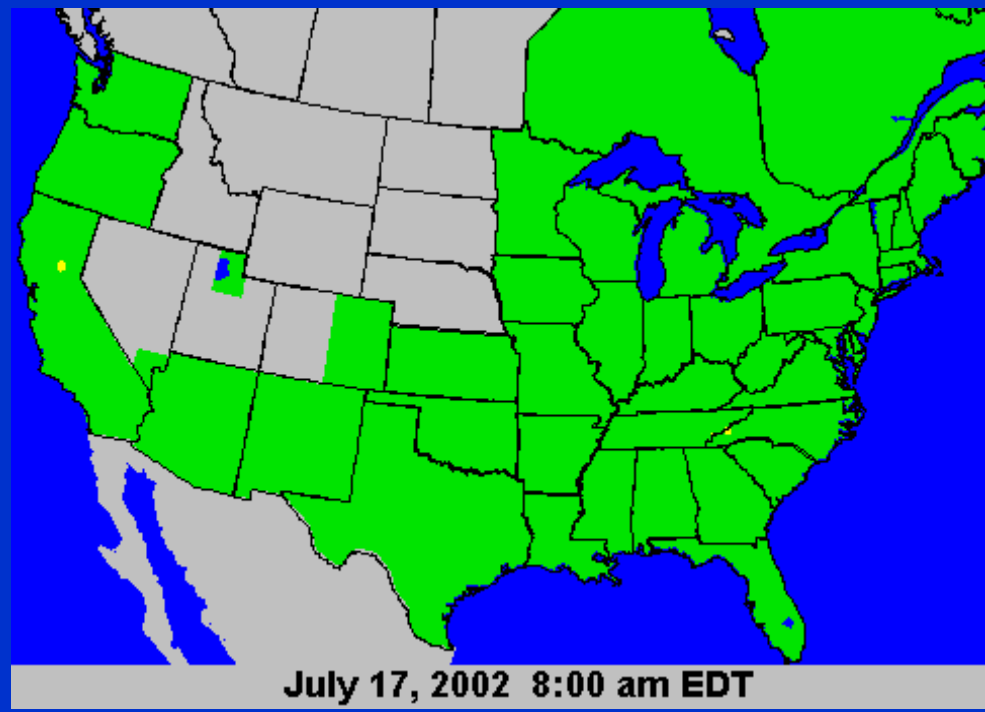
Daily Air Quality Forecasts



The Weather Channel

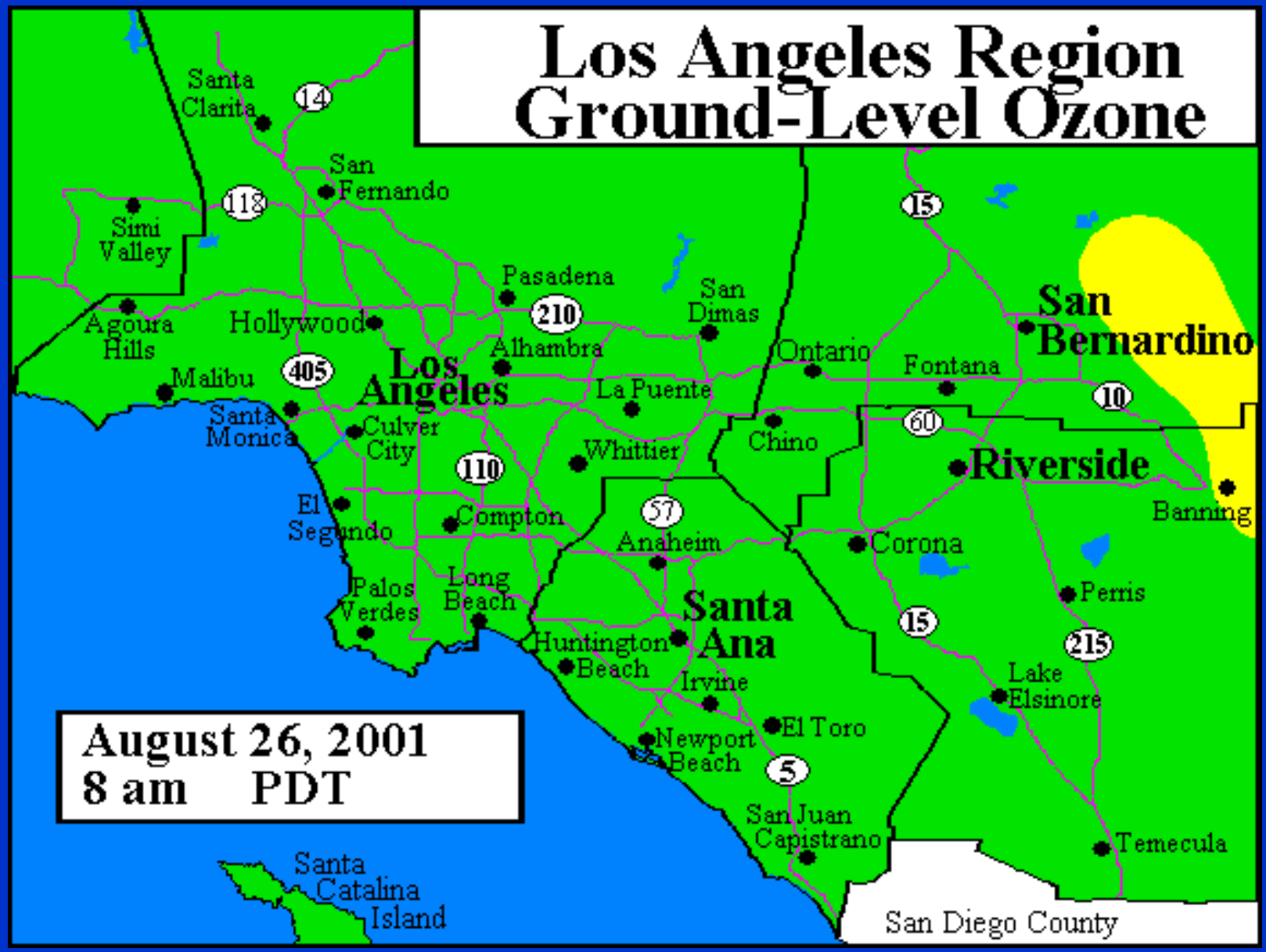
Ozone Maps

National

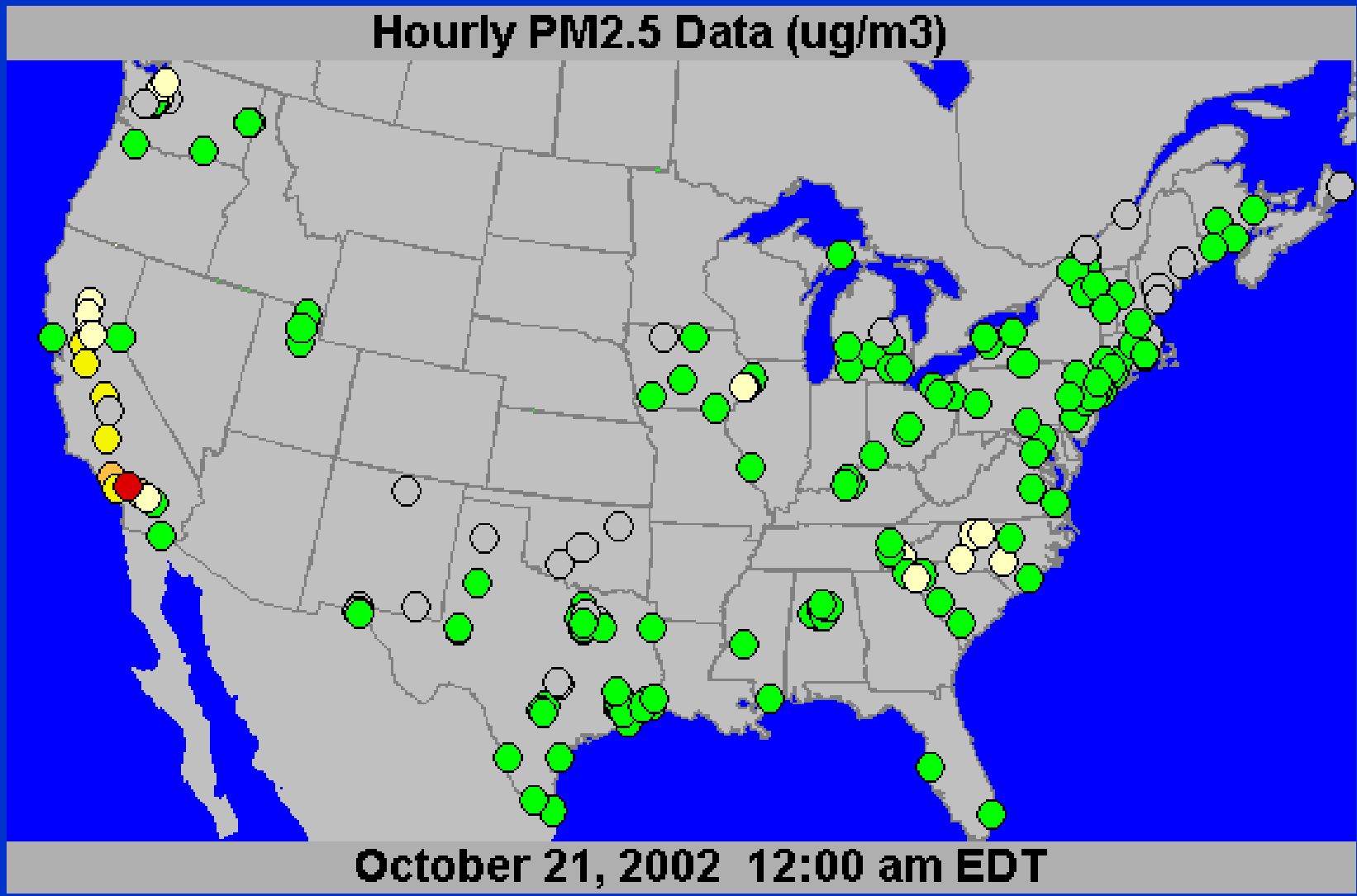


Regional

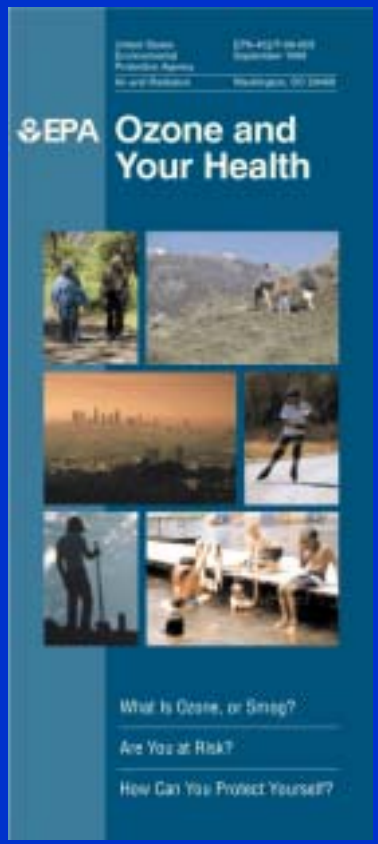
Local Conditions

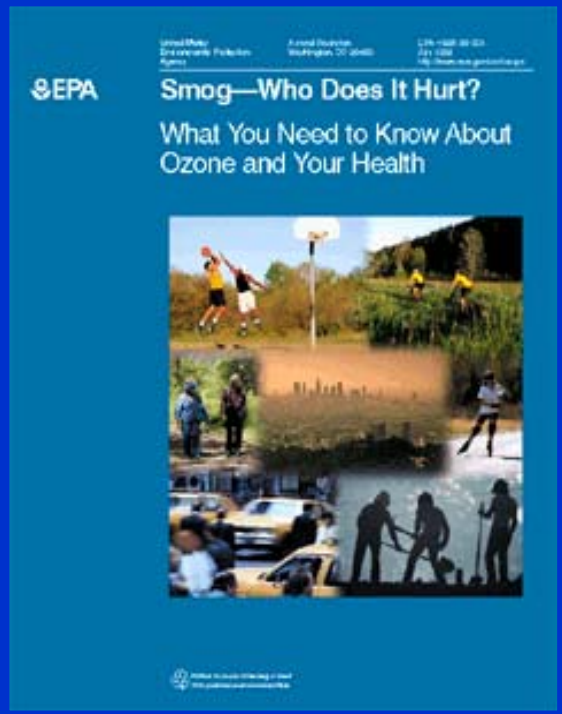


Real-time AQI for $PM_{2.5}$



Information Products





http://www.epa.gov/airnow/publications.html